



# **Mark Scheme (Results)**

Summer 2018

Pearson Edexcel International A Level  
in Statistics S1 (WST01/01)

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

## EDEXCEL IAL MATHEMATICS

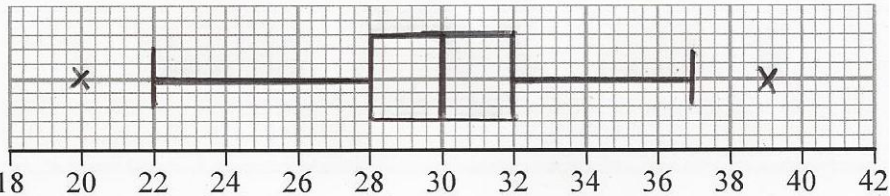
### General Instructions for Marking

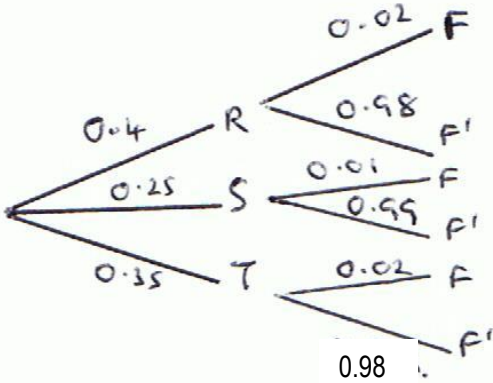
1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
  - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
  - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
  - **B** marks are unconditional accuracy marks (independent of M marks)
  - Marks should not be subdivided.
3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes.

- bod – benefit of doubt
  - ft – follow through
  - the symbol  $\surd$  will be used for correct ft
  - cao – correct answer only
  - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
  - isw – ignore subsequent working
  - awrt – answers which round to
  - SC: special case
  - oe – or equivalent (and appropriate)
  - dep – dependent
  - indep – independent
  - dp decimal places
  - sf significant figures
  - \* The answer is printed on the paper
  - $\square$  The second mark is dependent on gaining the first mark
4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.
  5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.
  6. Ignore wrong working or incorrect statements following a correct answer.

Question Number	Scheme	Marks
<b>1.(a)</b>	$S_{yy} = 2628.25 - \frac{141.5^2}{10} = 626.025^*$	M1A1cso (2)
<b>(b)</b>	$r = \frac{74.664}{\sqrt{9.25924 \times 626.025}}$ $= 0.98068\dots$ <p style="text-align: right;">awrt <b><u>0.981</u></b></p>	M1 A1 (2)
<b>(c)</b>	$r \text{ '0.981' is close to 1 or a strong correlation.}$	B1 (1)
<b>(d)</b>	$b = \frac{74.664}{9.25924} [= 8.063728\dots]$ $a = \frac{141.5}{10} - \left(\frac{74.664}{9.25924}\right) \times \left(\frac{49.04}{10}\right) = -25.39452\dots$ <p style="text-align: right;"><u><math>y = -25.4 + 8.06x</math></u></p>	M1 M1 A1 (3)
<b>(e)</b>	$y = -25.4 + 8.06 \times 4.4 [= 10.08\dots]$ $m = (10.08\dots) + 25$ $= 35.085\dots \text{(mpg)}$ <p style="text-align: right;">awrt <b><u>35.1</u></b></p>	M1 depM1 A1 (3)
<b>(f)</b>	As $44(p)/4.4(x)$ is within the range of the data set or it involves <u>interpolation</u> , (the actual miles per gallon should be) <u>reliable</u> .	M1 A1 (2)
<b>Notes</b>		Total 13
<b>(a)</b>	M1 Attempt at correct expression with $\sum y$ between 100 and 200 Allow complete expression with $\Sigma y = (30 + 3 + 22 + 15 + 13 + 8 + 15 + 13.5 + 3 + 19)$ A1 cso	
<b>(b)</b>	M1 Attempt at correct formula (allow one transcription error) [Condone use of their $S_{yy}$ ] A1 awrt 0.981 0.98 or 0.980 on its own is M1A0.	
<b>(c)</b>	B1 allow “near perfect” correlation, but “perfect correlation” is B0 If $ r  > 1$ , then B0. Points lie close to a straight line on its own is B0. “Strong relationship” is B0.	
<b>(d)</b>	M1 for a correct expression for $b$ M1 for a correct expression for $a$ ft their $b$ (watch out for 141.5 and 49.04 as these are sums) A1 correct equation (must be in part (d)) in $y$ and $x$ with $a =$ awrt $-25.4$ and $b =$ awrt $8.06$ [No fractions]	
<b>(e)</b>	M1 subst. $x = 4.4$ into their equation  depM1 adding 25 to their 10.08... A1 awrt 35.1	M1 a correct (ft) equation in $m$ and $p$ : $m - 25 = -25.4 + 8.06 \times \frac{p}{10}$ or better depM1 substituting $p = 44$ A1 awrt 35.1
<b>(f)</b>	M1 Needs to be clear that $p$ ( $36.5 < 44 < 68.9$ ) or $x$ ( $3.65 < 4.4 < 6.89$ ) is in the range. A1 M1 must be explicitly seen for this mark to be scored. ‘It is reliable as it is within range’ is M0A0 ISW after a correct comment is given.	

Question Number	Scheme	Marks
2.(a)	29	B1 (1)
(b)	Median = 30 IQR = 32 – 28 = 4	B1 M1 A1 (3)
(c)	'32'+1.5('4') [= 38] or '28'-1.5('4') [= 22]	M1
		B1 B1ft A1 (4)
(d)	<p><i>Westyou:</i>  <math>[Q_2 - Q_1 = 3, Q_3 - Q_2 = 1 \text{ or } (Q_2 - Q_1) &gt; (Q_3 - Q_2)] \Rightarrow \text{-ve(skew)}</math></p> <p><i>Eastyou:</i>  <math>[Q_2 - Q_1 = 2, Q_3 - Q_2 = 2 \text{ or } (Q_2 - Q_1) = (Q_3 - Q_2)] \Rightarrow \text{symmetrical}</math></p>	B1B1ft depB1 (3)
<b>Notes</b>		Total 11
(b)	<p>B1 30 (condone no label, but incorrect label is B0)  M1 Attempt to find both quartiles and subtract (at least one correct)  A1 4 cao (must be in part (b))</p>	
(c)	<p>M1 sight of '32'+1.5('4') or 38 or '28'-1.5('4') or 22  B1 box with one whisker drawn at each end  B1ft 22, their "28", their "30", their "32", 37 (allow 38) [Only ft their values from part (b)]  A1 20 and 39 marked as the only outliers  Note: A fully correct box plot with no working scores 4 out of 4.  If box plot is not drawn on the grid, then max possible score is M1B1B0A0.</p>	
(d)	<p>B1 <i>Westyou</i> negative skew  B1ft <i>Eastyou</i> symmetrical/no skew  If the mean is calculated as 30.03..., allow (slight) positive skew/symmetric for <i>Eastyou</i>  depB1 justification for <b>both</b> of the given statements (dep on both previous B marks)  Allow a comparison of the median to the quartiles in words for both e.g. 'The median is in the middle of the quartiles for <i>Eastyou</i> and the median is closer to the upper quartile for <i>Westyou</i> (than the lower quartile)' (or if mean is calculated, then allow mean &gt; median)</p>	
<b>Note:</b>	<p>If only one comment is made, then assume it is about <i>Eastyou</i> and B0B1B0 is possible.</p>	

Question Number	Scheme	Marks
<p>3(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	 <p><b>0.392</b></p> <p><math>0.4 \times 0.02 + 0.25 \times 0.01 + 0.35 \times 0.02 = \mathbf{0.0175}</math> (or exact equiv. e.g. <math>\frac{7}{400}</math>)</p> <p><math>[P(S'   F) = 1 - P(S   F)]</math>  <math>= \frac{0.4 \times 0.02 + 0.35 \times 0.02}{0.0175}</math> or <math>\frac{0.015}{0.0175}</math> or <math>1 - \frac{0.25 \times 0.01}{0.0175}</math>  <math>= \frac{6}{7}</math></p>	<p>M1</p> <p>A1</p> <p>(2)</p> <p>B1</p> <p>(1)</p> <p>M1 A1</p> <p>(2)</p> <p>M1</p> <p>A1</p> <p>(2)</p>
<b>Notes</b>		Total 7
<p><b>Allow equivalent fractions and percentages in all parts</b></p> <p>(a) M1 attempt at tree with first 3 branches with R labelled 0.4 and S labelled 0.25 <u>or</u> second 6 branches and F labelled 0.02, 0.01 and 0.02  A1 all branches, all labels and all 9 probabilities correct</p> <p>(b) Allow any exact equivalent e.g. <math>\frac{49}{125}</math></p> <p>(c) M1 <math>0.4 \times 0.02 + 0.25 \times 0.01 + 0.35 \times 0.02</math>  Allow ft from their tree diagram here for the M1 mark  A1 allow any exact equivalent e.g. <math>\frac{7}{400}</math></p> <p>(d) M1 <math>\frac{0.4 \times 0.02 + 0.35 \times 0.02}{(c)}</math> or <math>\frac{0.015}{(c)}</math> or <math>1 - \frac{0.25 \times 0.01}{(c)}</math> ft <math>0 &lt; \text{their (c)} &lt; 1</math>  Allow ft from their tree diagram for the numerator and ft from their (c) for the denominator  A1 allow awrt 0.857</p>		

Question Number	Scheme	Marks
4 (a)	$2k + k + k + 5k = 1$	M1
	$k = \frac{1}{9} *$	A1cso (2)
	(b) $P(1 \leq X < 4) = \frac{2}{9}$	B1 (1)
	(c) $E(X) = (1 \times) \frac{1}{9} + 2 \times \frac{1}{9} + 4 \times \frac{5}{9}$ or $E(X) = (1 \times) k + 2 \times k + 4 \times 5k [= 23k]$ $= \frac{23}{9}$ oe	M1 A1 (2)
	(d) $E(X^2) = 1 \times \frac{1}{9} + 2^2 \times \frac{1}{9} + 4^2 \times \frac{5}{9}$ or $E(X^2) = 1 \times k + 2^2 \times k + 4^2 \times 5k [= 85k]$ $= \frac{85}{9}$ oe	M1 A1 (2)
(e)	$\text{Var}(X) = \frac{85}{9} - \left(\frac{23}{9}\right)^2 [= 2.91\dots]$ $\text{Var}(3X+1) = 9 \times \left(\frac{85}{9} - \left(\frac{23}{9}\right)^2\right)$ $= \frac{236}{9}$ oe	M1 M1 A1 (3)

**Notes**

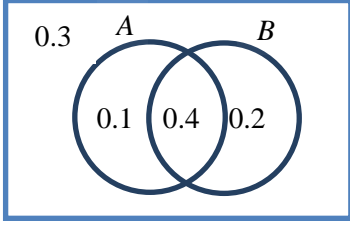
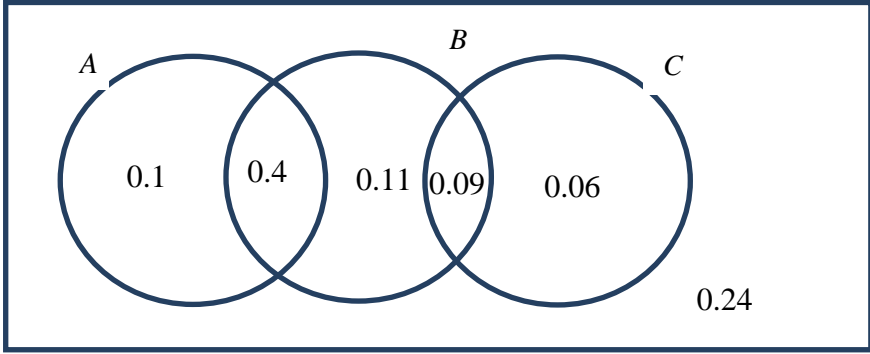
Total 10

	<table border="1" style="display: inline-table; margin-right: 10px;"> <tr> <td><math>x</math></td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> <tr> <td><math>P(X=x)</math></td> <td><math>2k</math></td> <td><math>k</math></td> <td><math>k</math></td> <td>0</td> <td><math>5k</math></td> </tr> </table>	$x$	0	1	2	3	4	$P(X=x)$	$2k$	$k$	$k$	0	$5k$
$x$	0	1	2	3	4								
$P(X=x)$	$2k$	$k$	$k$	0	$5k$								
(a)	<p>M1 A correct expression using <math>\sum p(x) = 1</math></p> <p>A1cso given answer with no incorrect working seen</p> <p>Verification Method:</p> <p>M1 <math>\frac{2}{9} + \frac{1}{9} + \frac{1}{9} + \frac{5}{9} = 1</math>                      A1cso therefore <math>k = \frac{1}{9}</math></p> <p><math>9k = 1</math> with no working scores M0A0, but allow <math>9k = 1</math> from a correct table.</p> <p><b>In parts (b), (c), (d) and (e) allow recurring decimals. ISW after correct answer seen.</b></p>												
(c)	<p>M1 Use of <math>\sum xp(x)</math> (3 non-zero terms and no extra. Allow at most 1 error or omission)</p> <p>A1 Allow exact equivalent e.g. <math>2\frac{5}{9}</math> or <math>2.\dot{5}</math></p>												
(d)	<p>M1 Use of <math>\sum x^2 p(x)</math> (3 non-zero terms and no extra. Allow at most 1 error or omission)</p> <p>A1 Allow exact equivalent e.g. <math>9\frac{4}{9}</math> or <math>9.\dot{4}</math></p>												
(e)	<p>M1 Use of <math>E(X^2) - [E(X)]^2</math></p> <p>M1 writing or using <math>9 \times \text{Var}(X)</math> or <math>9 \times</math> their <math>\text{Var}(X)</math> [<math>9 \times \frac{85}{9}</math> on its own is M0]</p> <p>A1 Allow exact equivalent e.g. <math>26\frac{2}{9}</math> or <math>26.\dot{2}</math></p>												



Question Number	Scheme	Marks
<p>5(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p> <p>(f)</p>	<p>0.9 &lt; x ≤ 1.1 group - width <b>0.5</b> (cm)</p> <p>1.5 cm<sup>2</sup> is 2 seeds <u>or</u> 6.75 cm<sup>2</sup> is 9 seeds <u>or</u> 0.5c = 6.75 <u>or</u> <math>\frac{9}{0.2} \times 0.3</math> oe</p> <p>0.9 &lt; x ≤ 1.1 group - height <b>13.5</b> (cm)</p> <p>The data/weights are <u>continuous</u></p> <p>Mean = 1.4125 awrt <b>1.41</b></p> $\sigma = \sqrt{\frac{101.56}{48} - \left(\frac{113}{80}\right)^2} = 0.347\dots \text{ awrt } \mathbf{0.347} \text{ (s = awrt 0.351)}$ <p>Median = [1.3] + <math>\frac{3}{11} \times 0.2</math> allow (n + 1) = [1.3] + <math>\frac{3.5}{11} \times 0.2</math> = awrt <b>1.35 or 1.355</b> (or if using (n + 1) allow awrt <b>1.36</b>)</p> <p><math>\frac{27}{48}</math> oe 0.5625 (allow 0.563)</p> <p>Mean increases <b>and</b> standard deviation decreases e.g. '∑fy increases (so the mean increases) <b>and</b> an extreme value has been replaced/data is more concentrated around the mean (so the standard deviation decreases)'</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>(3)</p> <p>B1</p> <p>(1)</p> <p>B1</p> <p>M1M1A1</p> <p>(4)</p> <p>M1</p> <p>A1</p> <p>(2)</p> <p>B1</p> <p>(1)</p> <p>B1</p> <p>depB1</p> <p>(2)</p>
	<b>Notes</b>	Total 13
<p>(a)</p> <p>(c)</p> <p>(d)</p> <p>(f)</p>	<p>M1 A correct statement comparing area and number of seeds allow their height × their width = 6.75 for M1</p> <p>B1 Allow <math>\frac{113}{80}</math> but not <math>\frac{67.8}{48}</math></p> <p>M1 attempt at <math>\frac{101.56}{48} - \mu^2</math> no need for square root (allow s)</p> <p>M1 using <math>\sqrt{\frac{101.56}{48} - \mu^2}</math> (allow s)</p> <p>M1 for a correct fraction: <math>[1.3] + \frac{3}{11} \times 0.2</math> or <math>m = 1.5 - \frac{8}{11} \times 0.2</math> Allow <math>\frac{[m-1.3]}{1.5-1.3} = \frac{24-21}{32-21}</math> oe to score the method mark A1 from correct working</p> <p>B1 for both correct comments depB1 dep on previous B1 for <b>complete</b> reasoning for both cases.</p>	

Question Number	Scheme	Marks
<p><b>6</b> (a)</p>	$\frac{15 - \mu}{\sigma} = 1.2816$ $\frac{5 - \mu}{\sigma} = -1.6449$ $10 = 2.9265\sigma$ $\sigma = 3.41705\dots$ $\mu = 10.6207\dots$ <p style="text-align: right;">awrt <b><u>3.42</u></b></p> <p style="text-align: right;">awrt <b><u>10.6</u></b></p>	<p>M1</p> <p>M1 B1</p> <p>depM1 A1</p> <p>A1</p> <p style="text-align: right;">(6)</p>
(b)	<p>Number of people = <math>[23 \times]P(L &gt; 12)</math></p> $= [23 \times]P\left(Z > \frac{12 - 10.6}{3.42}\right)$ $= 23 \times (1 - 0.6591)$ $\approx \text{awrt } 7.8 / \text{awrt } 7.9$	<p>M1</p> <p>depM1 A1</p> <p style="text-align: right;">(3)</p>
<b>Notes</b>		Total 9
(a)	<p>M1 <math>\pm \left(\frac{15 - \mu}{\sigma}\right) = (z \text{ value}) \quad 1 &lt;  z  &lt; 1.5</math></p> <p>M1 <math>\pm \left(\frac{5 - \mu}{\sigma}\right) = (z \text{ value}) \quad  z  &gt; 1.5</math></p> <p>B1 both <math>\pm 1.2816</math> or from calc <math>\pm 1.28155\dots</math> and <math>\pm 1.6449</math> or from calc <math>\pm 1.64485\dots</math></p> <p>depM1 solving simultaneous equations leading to an equation in one variable dependent on at least 1 previous M mark being scored.</p> <p>Note: Use of 0.8159 and 0.5199 (probabilities used as <math>z</math>-values) scores 0 out of 6.</p>	
(b)	<p>M1 for <math>P\left(Z &gt; \frac{12 - \text{their } 10.6}{\text{their } 3.42}\right)</math> only ft their <math>\sigma &gt; 0</math></p> <p>may be implied by <math>1 - (\text{a number in the range } 0.6554 - 0.6591)</math> or <math>0.34\dots</math></p> <p>depM1 dep on 1<sup>st</sup> M1 for <math>23 \times \text{their } P(L &gt; 12)</math> where <math>0 &lt; P(L &gt; 12) &lt; 0.5</math> or <math>23 - 23 \times 0.65\dots</math></p> <p>If their <math>\mu &gt; 12</math> then must be <math>23 \times \text{their } P(L &gt; 12)</math> where <math>0.5 &lt; P(L &gt; 12) &lt; 1</math></p> <p>A1 Must come from use of correct <math>\mu</math> and <math>\sigma = \text{awrt } 3.4</math> in part (a) (not ft)</p> <p>Allow 7 or 8 from correct working (and correct <math>\mu</math> and correct <math>\sigma</math>).</p>	

Question Number	Scheme	Marks
<p>7(a)</p> <p><math>P(A \cap B) = 0.4</math></p> <p><math>P(A B) = \frac{0.4}{P(B)}</math></p> <p><math>\frac{0.4}{P(B)} = \frac{2}{3}</math></p> <p><math>P(B) = 0.6</math></p> <p>(b)</p> <p><math>P(A' B') = \frac{0.5 + '0.4' - '0.6'}{1 - '0.6'} = \frac{3}{4}</math></p> <p>(c)</p> <p><math>P(B \cap C) = '0.6' \times 0.15</math>  <math>= 0.09</math></p> <p>(d)</p>	<p>May see:</p>  <p>(b)</p> 	<p>B1</p> <p>M1</p> <p>A1</p> <p>(3)</p> <p>M1</p> <p>A1</p> <p>(2)</p> <p>M1</p> <p>A1</p> <p>(2)</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>A1ft</p> <p>A1</p> <p>(5)</p>
<b>Notes</b>		Total 12
<p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	<p>M1 <math>\frac{\text{their } 0.4}{P(B)} = \frac{2}{3}</math> (an equation in <math>P(B)</math> only)</p> <p>Use of <math>P(A \cap B) = P(A) \times P(B)</math> is M0</p> <p>Correct answer scores 3 out of 3</p> <p>M1 <math>\frac{0.5 + \text{their } P(A \cap B) - \text{their (a)}}{1 - \text{their (a)}}</math></p> <p>M1 their (a) <math>\times 0.15</math> <math>0 &lt; \text{their (a)} &lt; 1</math></p> <p>M1 3 circles labelled <math>A, B</math> and <math>C</math> with <math>B</math> intersecting <math>A</math> and <math>C</math> and <math>P(A \cap C) = 0</math></p> <p>Do not allow blanks as 0s</p> <p>M1 0.09 and 0.06 <u>or</u> their (c) and 0.15 – their (c)</p> <p>M1 0.4 and 0.1 <u>or</u> probabilities in <math>A</math> such that <math>P(A) = 0.5</math></p> <p>A1ft 0.11 and 0.24 <u>or</u> all 6 probs add to 1 and probs. in <math>B</math> such that <math>P(B) = '0.6'</math> (dep on 1<sup>st</sup> M1)</p> <p>A1 all correct with box.</p> <p>NOTE: No labels allow access to 2<sup>nd</sup> and 3<sup>rd</sup> M1 marks ONLY</p>	